PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Power Plant Improvement Initiative (PPII)

10/2008

Achieving New Source Performance Standards (NSPS) Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion (completed)

A unique combination of high-tech combustion modifications and sophisticated control systems was planned to be tested on a coal-fired boiler at Sunflower Electric's Holcomb Power Station in Finney County, Kansas, to demonstrate how new technology can reduce air emissions and save costs for ratepayers. However, due to larger than anticipated costs for installation of new low-NO_x burners and overfire air system, Sunflower Electric Power Corporation withdrew the continuation application to DOE before proceeding to Phase III Budget Period 2 of the project, and DOE accepted Sunflower's withdrawal position.

The U.S. Department of Energy and Sunflower Electric Power Corporation planned to field test an integrated combustion-optimization system with the potential to reduce emissions of oxides of nitrogen (NO_x) from certain coal-fired electric generating units to between 0.15-0.22 lb NO_x/million Btu. This technology also has the potential to decrease heat rate and increase power output by 7 MW, and at much less cost than present of state-of-the-art NO_x control technology such as selective catalytic reduction (SCR). SCR technology uses chemical additives (ammonia) and catalysts to capture better than 90 percent of the NO_x pollutants from a power plant's flue gas before it exits the stack.

GE Energy and Environmental Research Corporation (now GE Energy) planned to provide the core technologies for demonstration at Sunflower Electric. Annual operating costs, while not fully evaluated, were not expected to be any higher than the cost of the currently installed technology. Comparative capital costs for SCR technology, however, are on the order of 4 to 5 times the cost of GE's planned combustion optimization system.

Sunflower's 360 MWe Wall-fired Holcomb Station

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PARTNER

Sunflower Electric Power Corporation
Garden City, KS

ADDITIONAL TEAM MEMBERS

GE Energy and Environmental Research Corp. (now GE Energy)

Electric Power Research Institute

Foster Wheeler Energy Corp.

LOCATION

Sunflower Electric's Holcomb Station
Garden City, Finney County, KS

COST

Total Project Value
$5,881,675

DOE/Non-DOE Share
$2,796,326 / $3,085,349

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The Holcomb unit was originally equipped with a "first-generation" low-NO_x burner design that reduced emissions by 50 percent from uncontrolled emission rates. Under this demonstration program, burner design was modified to optimize both the flame shape and the mixing of air and fuel, thereby optimizing combustion. Specific components were also planned to be added to the boiler, including a separated overfire air (SOFA) system. SOFA allows lean-burning operation of the burners by providing for the admission of additional air above the primary combustion zone. Advanced in-furnace sensors and coal flow measuring and control devices on each burner were included. A neural network or other artificially intelligent control technology was planned. Together, the burner modifications and the installation of the SOFA system and advanced combustion optimization components should have further reduced the remaining NO_x emissions by about 40 percent, with the SOFA system accounting for most (about three-fourths) of the 40 percent reduction. Boiler optimization was expected to reduce slagging (deposition of molten ash on boiler tubes) conditions and improve heat rate.

While applicable to all coal types, the low sulfur (less than 1 percent) and high reactivity of Powder River Basin coals lend themselves to the SOFA-based staging and inexpensive burner modifications that are at the core of the pollution reduction goals of this project.

During burner modifications and installation of advanced in-furnace sensors and coal flow measuring devices (Phases I and II of the project), burner performance did not achieve expectations and considerable slagging resulted. Sunflower decided that the best course of action would be to replace the modified burners with new low-NO_x burners and then proceed with the installation of the SOFA system (Phase III of the project). However, as stated above, Sunflower decided to withdraw the continuation application to DOE for proceeding to Phase III. The project is now in closeout. A final report has been received and approved. A DOE assessment has also been completed.

Benefits

Many utilities have selected SCR to control NO_x emissions. While SCR can achieve low NO_x levels, it is expensive, difficult to retrofit, reduces efficiency, and both uses and emits ammonia. The GE Combustion Optimization System used in this project has the potential to achieve nearly the same NO_x reductions as SCR in a simple retrofit with improved efficiency, no ammonia, and increased power generation. When concluded, the Holcomb project had the potential to consistently achieve the most stringent emission limits set by federal and state New Source Performance Standards - 0.15 pounds of NO_x per million Btu.

Advanced Low-NO_x Burner - 48" Outside Diameter